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PLACEMENT OF FISH HABITAT STRUCTURE INTO RICHMOND LAKE, SOUTH DAKOTA

South Dakota Department of Game, Fish and Parks

Wildlife Division
Joe Foss Building
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Placement of Fish Habitat Structure into Richmond Lake, South Dakota

by

Brian G. Blackwell
South Dakota Department of Game, Fish and Parks

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Preface

Information in this report was collected between May 2000 and December 2001. Funding for this project was provided by Federal Aid in Sportfish Restoration, (D-J) Project F-15-R, Job numbers 1586. Copies of this report and reference to the data can be made with written permission of the author or Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 East Capitol, Pierre, South Dakota, 57501.

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Abstract

Habitat structures were added to Richmond Lake, South Dakota during May and June 2000. The habitats consisted of Berkley Fish Habs and conifer trees. Three habitat configurations were used. One configuration consisted of eight Berkley Fish Habs connected together, a second configuration was eight connected Berkley Fish Habs placed adjacent to a conifer tree reef of similar size, and the third was a reef composed of conifer trees. Each configuration was represented four times. Attempts to monitor fish use of added habitats with an underwater camera failed because of poor water clarity. A bathymetric map of the lake was created using global positioning system and geographic information system.

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Structural complexity is important in mediating predator-prey population dynamics in aquatic ecosystems Crowder and Cooper (1979) indicated that structural complexity influences feeding efficiency and growth of predatory fishes and the distribution of their prey. Glass (1971) found intermediate structure densities to provide largemouth bass with an optimal long-term net energy return. At high structure densities, largemouth bass *Micropterus salmoides* had reduced prey (guppies *Poecilia reticulata)* capture efficiencies and at low densities, prey fish were extirpated. Cooper and Crowder (1979) believed the secret of obtaining persistent predator-prey interaction is strongly dependent on obtaining the correct combination of structure density and distribution.

Placement of various habitat types into aquatic systems has been extensively researched, but often has proven to be inconclusive because of confounding effects of depths, location or differences in fish populations and species composition (Johnson and Lynch 1992). Wege and Anderson (1979) stated that artificial structures for lakes and reservoirs were typically constructed from automobile tires, wooden stakes, hardwood trees, or softwood trees. Christmas trees are often indicated as a preferred structure because of their low cost and identified fish use. Johnson and Lynch (1992) recommended the use of Christmas trees for added habitat after evaluating Christmas trees, brush piles, and stake beds. They found pop-net catches of bluegill *Lepomis macrochirus* to be greatest from Christmas trees and reported anglers had their best catch success for bluegill and white crappie *Pomoxis annularis* when fishing near Christmas tree structures.

Added structures are generally colonized by periphyton, which attracts invertebrates and subsequently fishes. Wege and Anderson (1979) believed that adding artificial structure may influence both fish production and concentrating of fishes to varying degrees for different species. In pond studies, largemouth bass were found to have increased growth in ponds containing structure than those without during June (Wege and Anderson 1979). They speculated that structures may have created conditions that facilitated prey capture resulting in improved food conversion rates and ultimately improved relative growth.

Fisher (1996) found yellow perch *Perca flavescens* to spawn on added structures (conifers and periphyton-covered deciduous shrubs) at Lake Goldsmith, South Dakota. Whether production of yellow perch increased with the added structure was not evaluated. Hanchin (2001) evaluated the contribution of yellow perch eggs deposited on a tree reef composed of 500 conifers towards larval perch production at Lake Madison, South Dakota. He found that the reef may have contributed 14 to 37% of the total larval yellow perch hatch at Lake Madison, but the estimates had high confidence intervals.

Adding artificial structure to a featureless aquascape is known to concentrate fishes and likely increase angler catches. Walters et al. (1991) believed that artificial structures should be used when submerged structures are scarce and increased fish harvest was possible at no detriment to fish populations. Wege and Anderson (1979) observed significantly higher adult bluegill and largemouth bass angler and electrofishing catch rates in structured than in non-structured areas in pond experiments. They believed that artificial structure placement may increase the potential for largemouth bass overharvest. Five synthetic structures were evaluated for their utility of concentrating adult northern pike *Esox lucius* and largemouth bass in two 25-

ha Colorado warmwater impoundments (Rogers and Bergersen 1999). The synthetic structures were found to concentrate largemouth bass in previously underutilized lake regions when macrophyte beds were absent, but northern pike were not attracted to synthetic structures.

During reservoir construction many potential underwater obstructions are often removed, leaving the reservoir devoid of structural habitat. Subsequently, artificial habitat is often placed in lakes and reservoirs where naturally occurring structure is lacking. The objectives of this project were to establish artificial habitat, attempt to assess fish use of added artificial habitat, and create a bathymetric map of Richmond Lake, South Dakota.

Methods

<u>Study Site</u>

Richmond Lake is an 830 acre reservoir located in northeastern South Dakota. The reservoir has a maximum depth of 27.9 ft and mean depth of 14.8 ft. The reservoir was constructed in 1938 by impounding Foot Creek as part of a Works Progress Administration project (Monaghan 1970). Typical of most reservoir construction during this period, obstructions were removed resulting in a featureless aquascape. In addition, Monaghan (1970) reported that sediment had filled the preimpoundment channel and had smoothed the lake bottom. To augment the aquascape, the Northeastern South Dakota Walleye Club placed several hundred conifer trees into Richmond Lake during 1997, 1998, and 1999.

<u>Added Habitat</u>

Berkley Fish Hab units were selected as a synthetic fish habitat to be placed into Richmond Lake. Berkley Fish Hab units are constructed of plastic slats. Individual Fish Hab units were cube shaped with a height and length measurement of 4 ft. Fish Hab units were assembled on shore and placed into Richmond Lake during May and June 2000.

Three different habitat types were placed into Richmond Lake. One habitat type, consisted of eight Berkley Fish Hab units connected together (Figure 1). The second habitat type consisted of eight Berkley Fish Hab cubes connected together and placed adjacent to an equal sized conifer tree reef. The third habit type was composed of a mono conifer tree reef that approximated the size of eight Fish Hab cubes connected together.

Fish Habs and trees were anchored by attaching a sufficient number of concrete blocks. A pontoon boat was used to place structures at appropriate locations. Each habitat type was represented four times for a total of 12 habitat placements. Habitat placement occurred in the upper arm north of the north bridge access. Each habitat placement was georeferenced using a global positioning system (GPS) to acquire Universal Transverse Mercator (UTM) coordinates.

<u>Fish Habitat Use</u>

Attempts to assess fish use of habitats were made using an underwater camera (Aqua-Vu IR). Assessment of fish use was dependent on sufficient underwater visibility. Habitats were located using GPS and then the camera was used to attempt to scan the sides, top, and into each habitat unit.

Figure 1. Eight Berkley Fish Hab units connected together and ready to be placed into Richmond Lake, South Dakota.

Lake Mapping

The shoreline of Richmond Lake was mapped using GPS (Trimble TS 1 Asset Surveyor). Mapping was completed in a boat by traveling parallel to the shoreline and using an offset in the GPS receiver. Variable length segments were completed until an entire composite of the lake was obtained. Once the entire lake perimeter was available the composite file containing UTM's was imported into the GIS software ArcInfo (ESRI, RedIands, CA) as a line coverage using the GENERATE command. The BUILD procedure was then used to transform the line coverage into a polygon coverage. Edits to the coverage were made in ARCEDIT.

Depth data were collected with a liquid crystal display graph while traveling transects representing the entire lake. McMahon et al. (1996) indicated that when using transects for depth mapping, the number of transects depends on the spatial heterogeneity of depths; areas with rapidly changing depths require more transects. Collected depth data were combined with a shoreline map to create a depth contour map. Depth contours were created by interpolating between depth points using the Spatial Analyst module in ArcView (ESRI, RedIands, CA).

The shoreline development index (SDI) was used to describe the regularity of the shoreline. Shoreline development index was calculated with the equation

$$SDI = \frac{P}{2\sqrt{A\Pi}}$$

where P is the wetted perimeter of the lake shoreline and A is the surface area (Gallagher 1999). The volume was calculated by summing the volume of water at each depth as described by Gallagher (1999). Maximum depth was the deepest spot identified.

Results and Discussion

Structure Placement

With assistance from the Northeast South Dakota Walleye Club, habitat structures were placed into the northern portion of Richmond Lake during May 2000. Locations of the various habitats are shown in Figure 2. All structures were placed at sites where water depth exceeded 10 feet.

Fish Use

Poor water clarity did not allow for an evaluation of fish use. Similarly, Pope (1996) using SCUBA equipment and snorkeling was unable to visually verify black crappie *Pomoxis nigromaculatus* nest sites in Richmond Lake because of low visibility (< 3.9 inches). To be able to see the structures, the camera needed to be within 5 inches of the habitat. Because of this, the field of view was insufficient to see around and/or into the habitats. On a single occasion in October 2000 water clarity improved to approximately 12 inches and juvenile bluegills were observed using one of the Berkley Habitat Units. Although water clarity did not allow for evaluation, it is believed that fish did use the habitat structures as anglers located the structures and fished adjacent to them.

Mapping

Richmond Lake was found to have a surface area of 818.34 acres. The acreage is slightly less than the 829 acres reported by (Stueven and Stewart 1996). The maximum observed depth was 26.4 ft, which is also less than the 27.9 ft reported by Stueven and Stewart (1996). The SDI was calculated to be 5.6. Seventy one percent of Richmond Lake had a depth of less than 12 feet (Table 1). The deepest portions of the lake are located near the dam while the arms were shallow (Figures 3 -5).

The volume of Richmond Lake was determined to be 7,452 acre-feet. The calculated volume is considerably less than the 12,435 acre-feet reported by Stueven and Stewart (1996) or 8,971 acre feet reported by Monaghan (1970). Monhaghan (1970) indicated that 909.8 acre-feet (27.78 acre-feet per year) of sediment were deposited in Richmond Lake from dam completion (1937) until 1969. If sediment deposition remained at the rate of 27.78 acre-feet per year then between 1969 and 2001 approximately 888.96 acre-feet of silt would have been deposited.

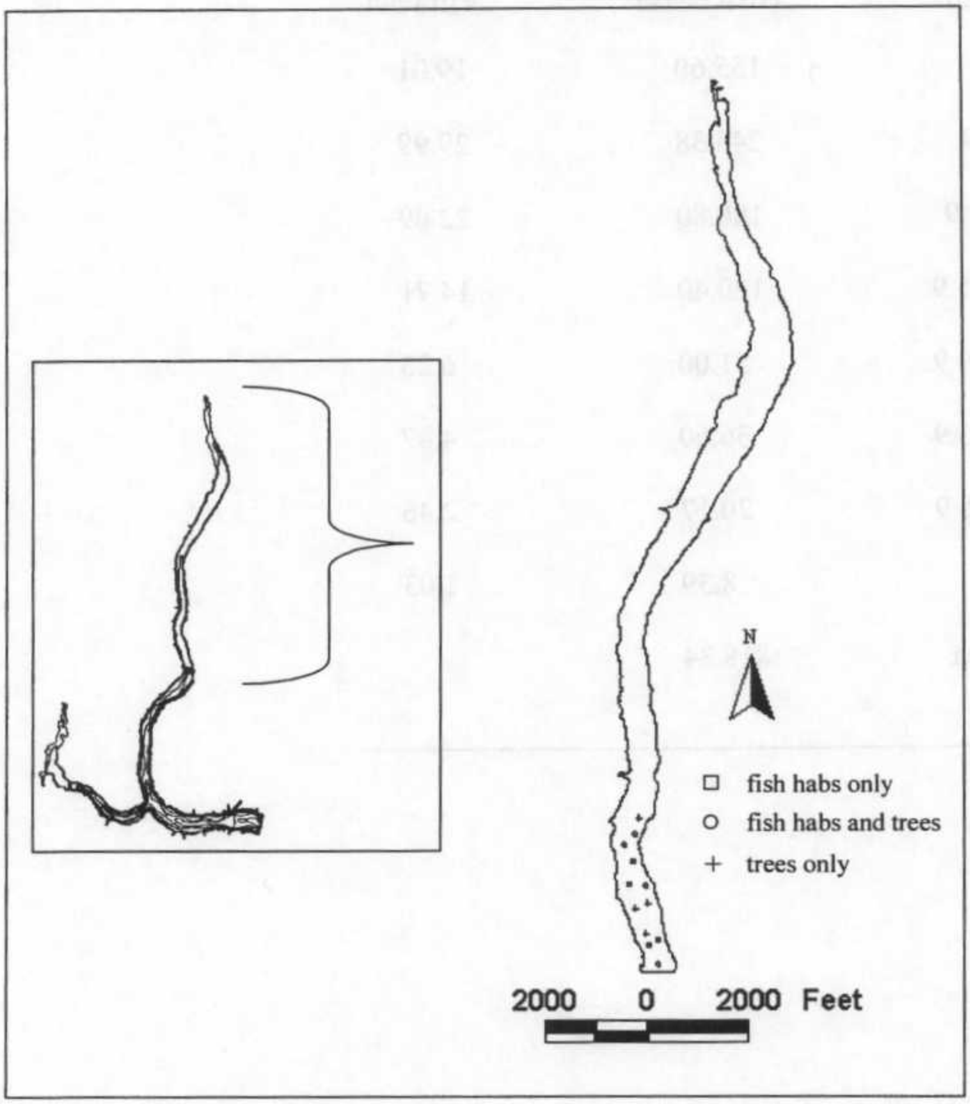

Figure 2. Locations of habitat units place in Richmond Lake, South Dakota.

Table 1. Estimated area and percent (%) of total area for each depth strata at Richmond Lake, South Dakota, July 2001.

Depth (ft)	Area (acre)	% of total
0-3.9	155.60	19.01
4.0-7.9	245.38	29.99
8.0 -11.9	180.80	22.09
12.0-15.9	120.40	14.71
16.0-19.9	51.00	6.23
20.0-23.9	36.60	4.47
24.0-25.9	20.17	2.46
>26	8.39	1.03
Total area	818.34	

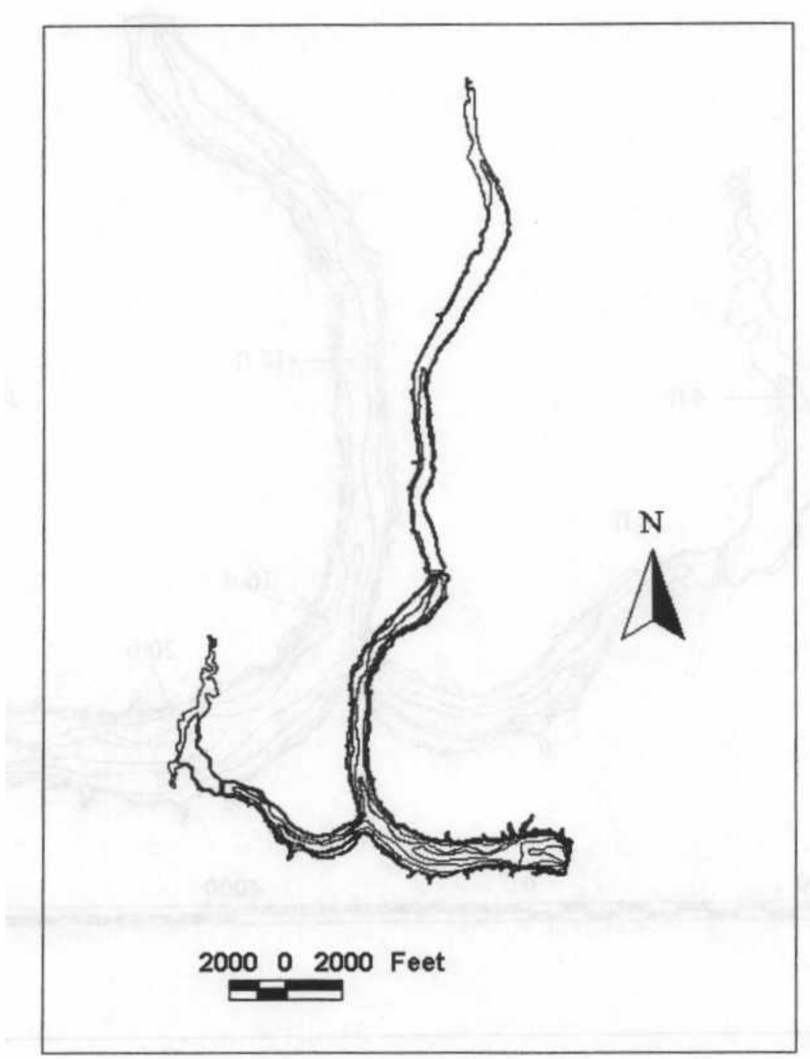

Figure 3. Bathymetric map depicting depth contours of Richmond Lake, South Dakota.

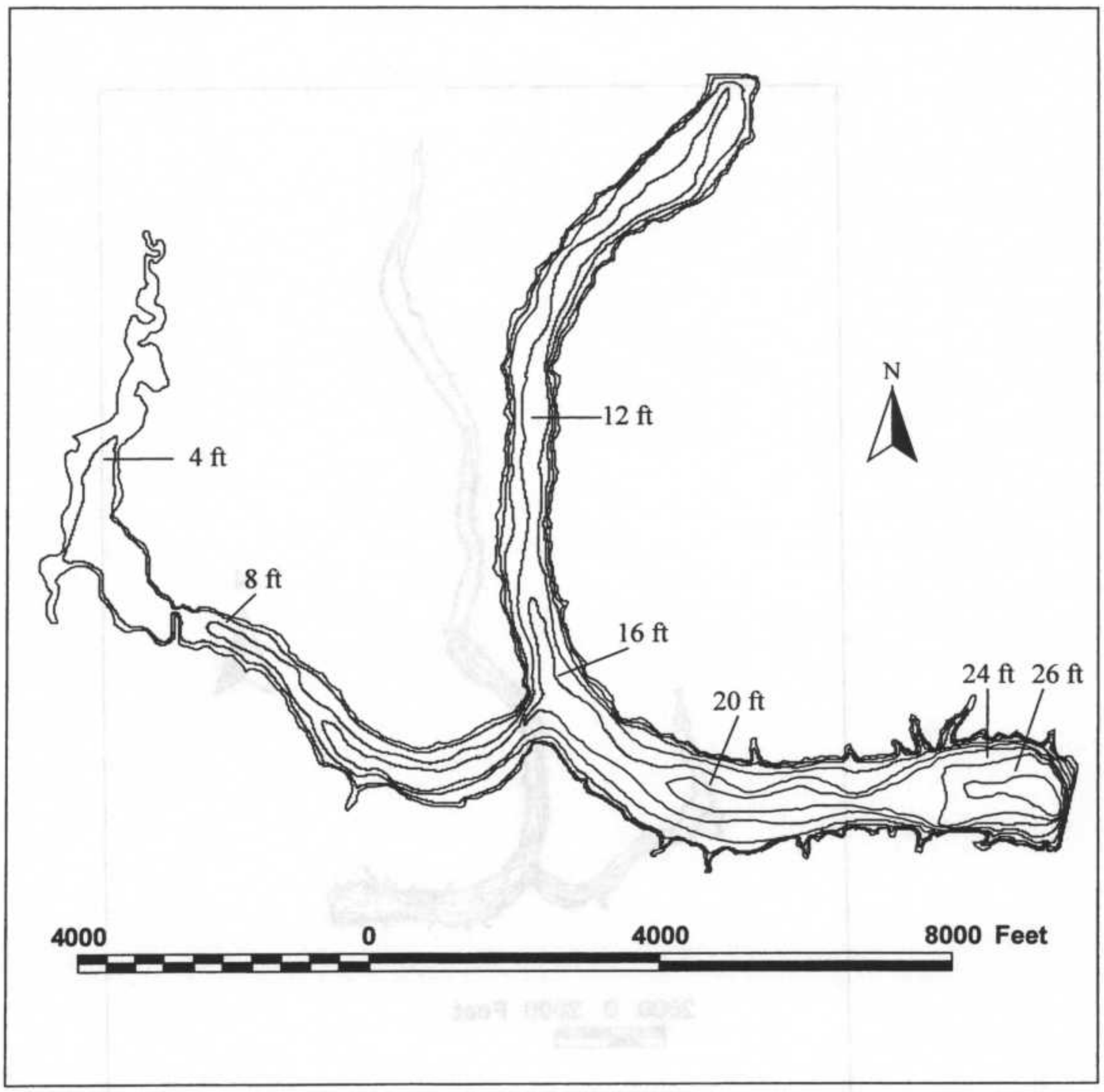

Figure 4. Bathymetric map depicting depth contours of the southern portion of Richmond Lake, South Dakota.

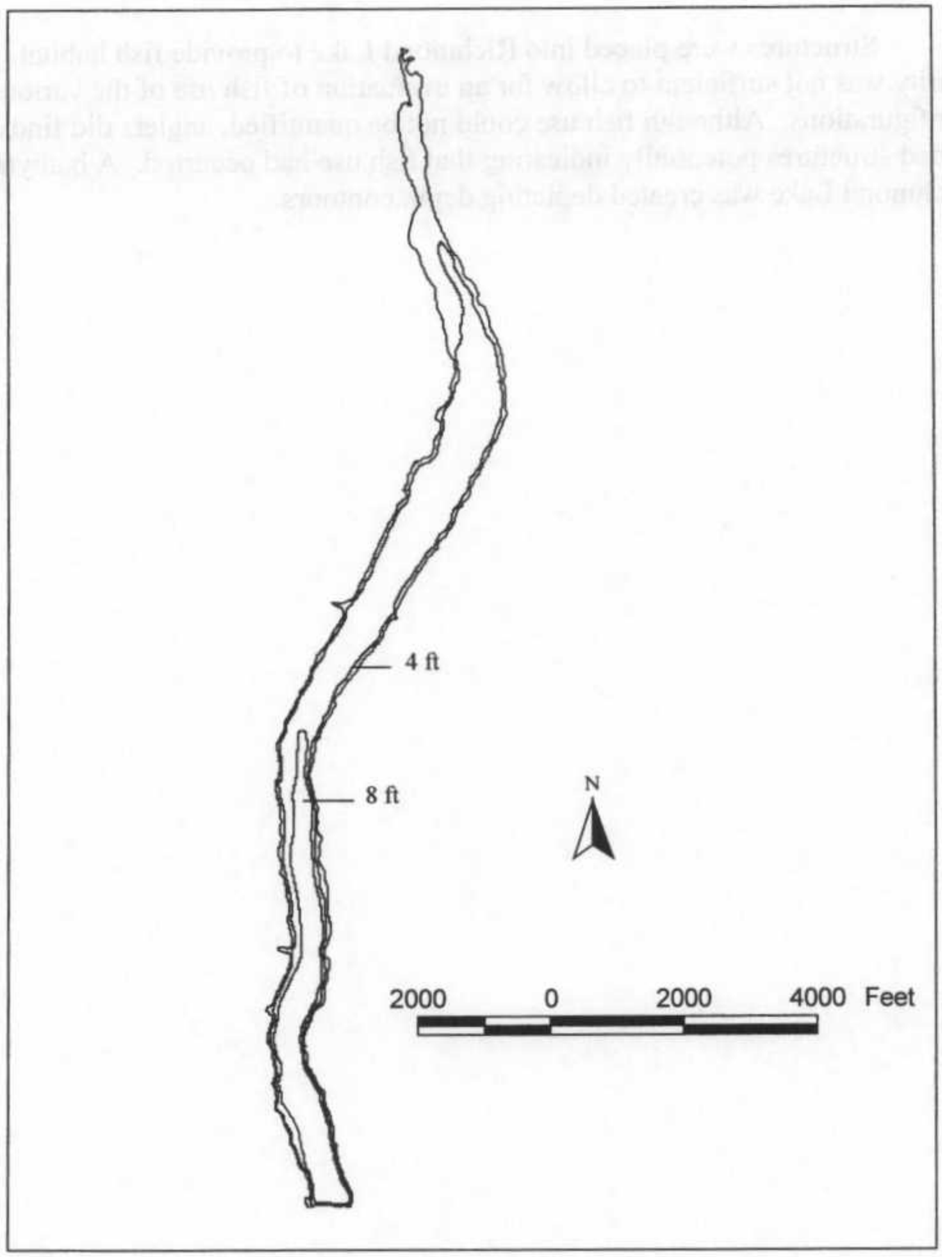

Figure 5. Bathymetric map depicting depth contours of the northern portion of Richmond Lake, South Dakota.

Summary

Structures were placed into Richmond Lake to provide fish habitat. Unfortunately water clarity was not sufficient to allow for an evaluation of fish use of the various habitat configurations. Although fish use could not be quantified, anglers did find and fish adjacent to added structures potentially indicating that fish use had occurred. A bathymetric map of Richmond Lake was created depicting depth contours.

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